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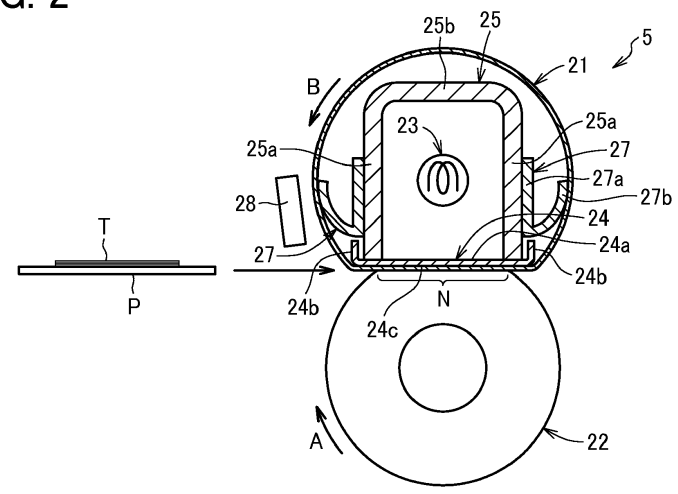
(54) FIXING DEVICE AND IMAGE FORMING APPARATUS INCORPORATING SAME

(57) A fixing device (5) comprising a cylindrical fixing member (21), an opposed member (22) disposed opposite an outer surface of the fixing member (21), a nip formation pad (24) disposed inside a loop of the fixing member (21) to sandwich the fixing member (21) with the opposed member (22) to form a nip between the fixing member (21) with the opposed member (22), a heater (23) disposed inside the loop of the fixing member (21) to heat the nip formation pad (24), a reflector (25) which includes a part of a surface facing the heater (23) and having a lower reflectance than the another part of the surface of the reflector (25), wherein at least a part of the reflector (25) is disposed between the fixing member (21) and the heater (23) in a cross-section that intersects the width direction of the fixing member (21) and corresponding image forming apparatus.

FIG. 2



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Description

BACKGROUND

Technical Field

[0001] Embodiments of the present disclosure generally relate to a fixing device and an image forming apparatus incorporating the fixing device.

Description of the Related Art

[0002] An electrophotographic image forming apparatus such as a copier and a printer includes a fixing device to convey a recording medium such as a sheet on which an unfixed image is formed to a nip formed between members such as a roller and a belt facing each other, heat the recording medium, and fix the unfixed image on the recording medium.

[0003] As such the fixing device, for example, JP2016-145852-A discloses the fixing device including a fixing belt, a nip plate disposed in an inner loop of the fixing belt, and a pressure roller disposed outside the fixing belt, and the fixing device has the nip formed on the fixing belt sandwiched by the nip plate and the pressure roller. In this fixing device, a reflector disposed around the heater reflects infrared light emitted from the heater toward the nip plate.

[0004] As described in JP2016-145852-A, since the infrared light emitted from the heater and reflected by the reflector easily heats the nip plate, the fixing device can be warmed up quickly and improve energy-saving. However, since a part of the infrared light reflected by the reflector irradiates the heater, when the heater is continuously used, a heat generated by the heater itself and a heat given by the infrared light reflected by the reflector may excessively raise a heater temperature, and the heater temperature may exceed the upper-temperature limit.

SUMMARY

[0005] It is a general object of the present disclosure to provide an improved and useful fixing device in which the above-mentioned problems are eliminated. In order to achieve the above-mentioned object, there is provided a fixing device according to claim 1. Advantageous embodiments are defined by the dependent claims.

[0006] Advantageously, the fixing device includes a cylindrical fixing member, an opposed member disposed opposite an outer surface of the fixing member, a nip formation pad disposed inside a loop of the fixing member to sandwich the fixing member with the opposed member to form a nip between the fixing member with the opposed member, a heater disposed inside the loop of the fixing member to heat the nip formation pad, and a reflector. The reflector includes a part of a surface facing the heater and having a lower reflectance than another part of the surface of the reflector, and at least a part of the reflector is disposed between the fixing member and the heater in a cross-section that intersects the width direction of the fixing member.

[0007] According to the present disclosure, the part of the surface of the reflector on the heater side having a lower reflectance than the other part of the surface of the reflector can prevent the heater from rising temperature excessively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The aforementioned and other aspects, features, and advantages of the present disclosure would be better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a schematic diagram illustrating a configuration of an image forming apparatus according to an embodiment;
FIG. 2 is a vertical cross-sectional view of a fixing device viewed from a lateral side of the fixing device;
FIG. 3 is a perspective view of the fixing device with the vertical cross-sectional view of the fixing device;
FIG. 4 is a vertical cross-sectional view of the fixing device viewed from a front side of the fixing device;
FIG. 5 is a perspective view of a belt holder;
FIG. 6 is a perspective view of a variation of the belt holder;
FIG. 7 is a vertical cross-sectional view of the fixing device according to a first embodiment viewed from the lateral side of the fixing device;
FIG. 8 is a vertical cross-sectional view of the fixing device according to a second embodiment viewed from the lateral side of the fixing device;
FIG. 9 is a vertical cross-sectional view of the fixing device according to a third embodiment viewed from the lateral side of the fixing device;
FIG. 10 is a vertical cross-sectional view of the fixing device according to a fourth embodiment viewed from the lateral side of the fixing device;
FIG. 11 is a vertical cross-sectional view of the fixing device according to a fifth embodiment viewed from the lateral side of the fixing device;
FIG. 12 is a vertical cross-sectional view of the fixing device according to a sixth embodiment viewed from the lateral side of the fixing device;
FIG. 13 is a vertical cross-sectional view of the fixing device according to a seventh embodiment viewed from the lateral side of the fixing device;
FIG. 14 is a vertical cross-sectional view illustrating a structure of an end portion of a reflector; and
FIG. 15 is a schematic diagram illustrating an example of a configuration of the image forming apparatus including the fixing device that conveys a sheet in a vertical direction.

[0009] The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted.

DETAILED DESCRIPTION OF EMBODIMENTS

[0010] In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this specification is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that have a similar function, operate in a similar manner, and achieve a similar result.

[0011] Although the embodiments are described with technical limitations with reference to the attached drawings, such description is not intended to limit the scope of the disclosure and all of the components or elements described in the embodiments of this disclosure are not necessarily indispensable.

[0012] Referring now to the drawings, embodiments of the present disclosure are described below. In the drawings illustrating the following embodiments, the same reference codes are allocated to elements (members or components) having the same function or shape and redundant descriptions thereof are omitted below.

[0013] FIG. 1 is a schematic diagram illustrating a configuration of an image forming apparatus according to an embodiment of the present disclosure. Referring to FIG. 1, a configuration and operation of the image forming apparatus according to the present embodiment are described below.

[0014] An image forming apparatus 1 illustrated in FIG. 1 is a monochrome electrophotographic laser printer. The image forming apparatus 1 according to the embodiments of the present disclosure may be a copier, a facsimile machine, a multifunction peripheral (MFP) having at least two of copying, printing, scanning, facsimile, and plotter functions in addition to the printer. The image forming apparatus 1 is not limited to a monochrome image forming apparatus and may be a color image forming apparatus.

[0015] As illustrated in FIG. 1, the image forming apparatus 1 includes an image forming device 2 to form an image, a recording medium feeding device 3 to feed a sheet P as a recording medium to the image forming device 2, a transfer device 4 to transfer the image onto the fed sheet P, a fixing device 5 to fix the image transferred onto the sheet P, and a sheet ejection device 6 to eject the sheet P with the fixed image to an outside of the image forming apparatus 1.

[0016] The image forming device 2 includes a drum-shaped photoconductor 7, a charging roller 8 as a charging device to charge a surface of the photoconductor 7, an exposure device 9 as a latent image forming device that exposes the surface of the photoconductor 7 to form an electrostatic latent image on the photoconductor 7, a developing roller 10 as a developing device that supplies toner as a developer to the surface of the photoconductor 7 to visualize the electrostatic latent image, and a cleaning blade 11 as a cleaner to clean the surface of the photoconductor 7.

[0017] As an image forming operation start is instructed, in the image forming device 2, the photoconductor 7 starts to rotate, and the charging roller 8 uniformly charges the surface of the photoconductor 7 to a high potential. Next, based on image data of an original document read by a scanner or print data instructed by a terminal device, the exposure device 9 exposes the surface of the photoconductor 7. Potential of an exposed surface drops, and the electrostatic latent image is formed on the photoconductor 7. The developing roller 10 supplies toner to the electrostatic latent image, thereby developing the latent image into the toner image on the photoconductors 7.

[0018] The toner image formed on the photoconductor 7 is transferred onto the sheet P in a transfer nip between the photoconductor 7 and a transfer roller 15 disposed in the transfer device 4. The sheet P is fed from the recording medium feeding device 3. In the recording medium feeding device 3, a sheet feeding roller 13 feeds the sheet P from a sheet tray 12 to a feeding path one by one. A timing roller pair 14 sends out the sheet P fed from the sheet tray 12 to the transfer nip, timed to coincide with the toner image on the photoconductor 7. The toner image on the photoconductor 7 is transferred onto the sheet P at the transfer nip. After the toner image is transferred from the photoconductors 7 onto the sheet P, the cleaning blade 11 removes residual toner on the photoconductor 7.

[0019] The sheet P bearing the toner image is conveyed to the fixing device 5. In the fixing device 5, heat and pressure when the sheet P passes through between the fixing belt 21 and the pressure roller 22 fixes the toner image to the sheet P. Subsequently, the sheet P is conveyed to the sheet ejection device 6, and an ejection roller pair 16 ejects the sheet P outside the image forming apparatus 1, and a series of print operations are completed.

[0020] With reference to FIGS. 2 to 6, a detailed description is provided of a construction of the fixing device 5.

[0021] FIG. 2 is a vertical cross-sectional view of the fixing device 5 viewed from a lateral side of the fixing device 5, FIG. 3 is a perspective view of the fixing device 5 with the vertical cross-sectional view of the fixing device 5, and FIG. 4 is a vertical cross-sectional view of the fixing device 5 viewed from a front side of the fixing device 5. In addition, FIG. 5 is a perspective view of a belt holder 30 to support the fixing belt 21, and FIG. 6 is a perspective view of a variation of the belt holder.

[0022] As illustrated in FIG. 2, the fixing device 5 includes the fixing belt 21, the pressure roller 22, a halogen heater 23, a nip formation pad 24, a reflector 25, guides 27, and temperature sensors 28.

[0023] The fixing belt 21 is a cylindrical fixing member to fix an unfixed image T to the sheet P and is disposed on the side of the sheet P on which the unfixed image is held. The fixing belt 21 in the present embodiment is an endless belt or film, including a base layer formed on the inner side of the fixing belt 21 and made of a metal such as nickel and stainless steel (SUS) or a resin such as polyimide, and a release layer formed on the outer side of the fixing belt 21 and made of tetrafluoroethylene-perfluoroalkylvinylether copolymer (PFA), polytetrafluoroethylene (PTFE), or the like. Optionally, an elastic layer made of rubber such as silicone rubber, silicone rubber foam, and fluoro rubber may be interposed between the base layer and the release layer. While the fixing belt 21 and the pressure roller 22 press the unfixed toner image onto the sheet P to fix the toner image on the sheet P, the elastic layer having a thickness of about 100 micrometers elastically deforms to absorb slight surface asperities of the fixing belt 21, preventing variation in gloss of the toner image on the sheet P. Additionally, in the present embodiment, the fixing belt 21 is thin and has a small loop diameter to decrease the thermal capacity of the fixing belt 21. For example, the base layer of the fixing belt 21 has a thickness of from 20 μm to 50 μm and the release layer has a thickness of from 10 μm to 50 μm. Thus, the fixing belt 21 has a total thickness not greater than 1 mm. In addition, when the fixing belt 21 includes the elastic layer, the thickness of the elastic layer may be set to 100 to 300 μm. In order to decrease the thermal capacity of the fixing belt 21 further, the fixing belt 21 may have a total thickness not greater than 0.20 mm and preferably not greater than 0.16 mm. In the present embodiment, the fixing belt 21 may have a loop diameter from 20 to 40 mm and preferably 30 mm or less.

[0024] The pressure roller 22 is an opposed member disposed opposite an outer circumferential surface of the fixing belt 21. The pressure roller 22 is constructed of a cored bar, an elastic layer coating the cored bar, and a release layer coating the elastic layer. The elastic layer is made of rubber such as silicone rubber form and fluororubber. The release layer is made of PFA or PTFE. According to the present embodiment, the pressure roller 22 is a solid roller. Alternatively, the pressure roller 22 may be a hollow roller. When the pressure roller 22 is a hollow roller, a heat source such as a halogen heater may be disposed inside the pressure roller 22. The elastic layer of the pressure roller 22 may be made of solid rubber. Alternatively, if no heater is disposed inside the pressure roller 22, the elastic layer of the pressure roller 22 is preferably made of sponge rubber to enhance thermal insulation of the pressure roller 22. This reduces heat conduction from the fixing belt 21 to the pressure roller 22 and improves heating efficiency of the fixing belt 21.

[0025] A driver inside the image forming apparatus 1 drives and rotates the pressure roller 22 in a direction indicated by arrow A in FIG. 2. The rotation of the pressure roller 22 drives the fixing belt 21 to rotate in a direction B in FIG. 2 due to frictional force therebetween. After the toner image is transferred onto the sheet P, the sheet P bearing the unfixed toner image is conveyed to a nip N between the fixing belt 21 and the pressure roller 22. The rotating fixing belt 21 and the rotating pressure roller 22 conveys the sheet P, and the sheet P passes through the nip N. When the sheet P passes through the nip N, heat and pressure applied to the sheet P fixes the unfixed image T to the sheet P.

[0026] The pressure roller 22 and the fixing belt 21 are configured to be able to contact and separate each other. If the sheet is jammed in the nip N, separating the pressure roller 22 and the fixing belt 21 from each other and opening the nip N enables the jammed sheet to be removed. The pressure roller 22 and the fixing belt 21 may be configured so that one is fixed and the other is movable to be able to contact and separate from each other, or both the pressure roller 22 and the fixing belt 21 may be configured to move, thereby alternately contacting and separating from each other.

[0027] The halogen heater 23 is a heater disposed inside a loop of the fixing belt 21 and emitting infrared light including far infrared light or near infrared light, and radiant heat from the halogen heater 23 heats the fixing belt 21 from the inside. Alternatively, instead of the halogen heater 23, a carbon heater, a ceramic heater or the like may be employed as the heater. In the present embodiment, only one halogen heater 23 is disposed in the loop of the fixing belt 21, but a plurality of halogen heaters 23 having different heat-generating areas may be used according to the width size of the sheet.

[0028] The nip formation pad 24 and the pressure roller 22 sandwich the fixing belt 21 to form the nip N. Specifically, the nip formation pad 24 extends in a longitudinal direction thereof parallel to a width direction of the fixing belt 21 and has a planar nip formation portion 24a that is in contact with an inner circumferential surface of the fixing belt 21 and a pair of bent portions 24b that are bent from both end portions of the nip formation portion 24a in a belt rotation direction B to the opposite side to the pressure roller 22. A pressure member such as a spring presses the pressure roller 22 against the nip formation pad 24, which causes the pressure roller 22 to contact the fixing belt 21 and forms the nip N therebetween.

[0029] A nip formation surface 24c on the nip formation portion 24a facing the fixing belt 21 directly contacts the inner circumferential surface of the fixing belt 21. Therefore, when the fixing belt 21 rotates, the fixing belt 21 slides along the nip formation surface 24c. In order to improve the abrasion resistance and the slidability of the nip formation surface 24c, the nip formation surface 24c may be coated with an alumite treatment layer or a fluororesin material. Furthermore, a lubricant such as a fluorine-based grease may be applied to the nip formation surface 24c in order to ensure slidability over time. In the present embodiment, the nip formation surface 24c is planar. Alternatively, the nip formation surface 24c may define a recess or other shapes. For example, the nip formation surface 24c having a concave shape recessed

to the side opposite to the pressure roller 22 leads the outlet of the sheet in the nip N to be closer to the pressure roller 22, which improves separation of the sheet from the fixing belt 21.

[0030] The nip formation pad 24 is made of a material having a thermal conductivity greater than a thermal conductivity of the reflector 25. For example, the material of the nip formation pad 24 is preferably copper (thermal conductivity: 398 W / mk) or aluminum (thermal conductivity: 236 W / mk). The nip formation pad 24 made of the material having such a large thermal conductivity absorbs the radiant heat from the halogen heater 23 and effectively transmits heat to the fixing belt 21. For example, setting the thickness of the nip formation pad 24 to 1 mm or less can shorten a heat transfer time in which the heat transfers from the nip formation pad 24 to the fixing belt 21, which is advantageous in shortening a warm-up time of the fixing device 5. In contrast, setting the thickness of the nip formation pad 24 larger than 1 mm and 5 mm or less can improve a heat storage capability of the nip formation pad 24.

[0031] The reflector 25 reflects the radiant heat that is the infrared light from the halogen heater 23, and at least a part of the reflector 25 is interposed between the fixing belt 21 and the halogen heater 23 in a cross-section that intersects the width direction of the fixing belt 21. Similar to the nip formation pad 24, the reflector 25 extends in a longitudinal direction thereof parallel to the width direction of the fixing belt 21 and inside the loop of the fixing belt 21. In the present embodiment, the reflector 25 has a U-shaped cross-section including a pair of side wall portions 25a and a bottom wall portion 25b that connects the pair of side wall portions 25a. The pair of side wall portions 25a of the reflector 25 supports both ends of the nip formation pad 24 in the belt rotation direction B. The side wall portions 25a extending in a pressure direction in which the pressure roller 22 presses the nip formation pad 24 that is a vertical direction in FIG. 2 strengthens the rigidity of the reflector 25 in the pressure direction and reduces the bending of the nip formation pad 24 caused by the pressure force of the pressure roller 22. This results in a uniform width of the nip N in the longitudinal direction. The reflector 25 is preferably made of an iron-based metal such as stainless steel (SUS) or Steel Electrolytic Cold Commercial (SECC) that is electrogalvanized sheet steel to ensure rigidity.

[0032] The guides 27 are disposed inside the loop of the fixing belt 21 to guide the rotating fixing belt 21. In the present embodiment, the guides 27 are disposed on both the upstream side and the downstream side of the nip N in the belt rotational direction B. The guide 27 includes an attachment portion 27a fixed to the reflector 25 and a curved guide portion 27b in contact with the inner peripheral surface of the fixing belt 21. As illustrated in FIG. 3, the guide portion 27b includes a plurality of ribs 27c that are projections provided at equal intervals in the belt width direction on a guide surface of the guide portion 27b that is the surface of the guide portion 27b in the fixing belt 21 side. Guiding the fixing belt 21 along the guide surface having the plurality of ribs 27c enables smooth rotation of the fixing belt 21 without large deformation of the fixing belt 21.

[0033] The temperature sensors 28 are disposed outside the loop of the fixing belt 21 and detect temperatures of the fixing belt 21. In the present embodiment, the temperature sensors 28 are disposed at two positions, the central position of the fixing belt 21 in the belt width direction and one end position of the fixing belt 21 in the belt width direction. Output of the halogen heater 23 is controlled based on the temperatures of the outer circumferential surfaces of the fixing belt 21 detected by the temperature sensors 28. Thus, the temperature of the fixing belt 21 is adjusted to a desired fixing temperature. The temperature sensors 28 may be either contact type or non-contact type. The temperature sensors 28 may be a known temperature sensor type such as a thermopile, a thermostat, a thermistor, or a non-contact (NC) sensor.

[0034] As illustrated in FIG. 4, a pair of belt holders 30 is inserted in both lateral ends of the fixing belt 21 in the axial direction thereof, respectively, to rotatably support the fixing belt 21. As described above, the belt holders 30 inserted in the inner periphery of the fixing belt 21 support the fixing belt 21 in a state in which no tension in the circumferential direction is applied when the fixing belt 21 does not rotate, that is, the so-called free belt method.

[0035] As illustrated in FIGS. 3 to 5, the belt holder 30 includes a C-shaped supporter 30a inserted in the inner periphery of the fixing belt 21 to support the fixing belt 21 and a flange 30b that contacts an end face of the fixing belt 21 to stop a movement of the fixing belt 21 in the width direction, that is, a lateral shift of the fixing belt. As illustrated in FIG. 6, the supporter 30a may have a cylindrical shape which is continuous over the entire circumference. As illustrated in FIG. 4, each of the belt holders 30 is fixed on a pair of side plates 31 that are frames of the fixing device 5. The belt holder 30 defines an opening 30c as illustrated in FIG. 5, and both ends of the halogen heater 23 and the reflector 25 are fixed to the side plates 31 through the openings 30c. The halogen heater 23 and the reflector 25 may be fixed to the belt holder 30.

[0036] A detailed description is provided of a configuration of the reflector 25 according to a first embodiment.

[0037] As illustrated in FIG. 7, a reflection face 40 is formed on the inner surface (the surface facing the halogen heater 23) of the reflector 25 to reflect the radiant heat that is the infrared light from the halogen heater 23. In the present embodiment, the reflection face 40 is formed by applying reflective material on a base of the reflector 25 made of iron-type metal material. Alternatively, instead of applying the reflective material, the reflection face 40 may be formed by polishing the surface of the base of the reflector 25 that is the surface facing the halogen heater 23.

[0038] The reflection face in the present disclosure has

a reflectance of 70% or more with respect to the infrared light from the heater. For example, the reflection face 40 has a reflectance of 70% or more with respect to light having a wavelength of 900 to 1600 nm, or a reflectance of 70% or more with respect to light having a wavelength of 1000 to 1300 nm, which are wavelengths of infrared light of the heater generally used in the fixing device. The reflectance may be measured by a known method using the spectrophotometer that is, for example, the ultraviolet visible infrared spectrophotometer UH4150 manufactured by Hitachi High-Tech Science Corporation in which the incident angle is set 5°.

[0039] The reflection face 40 formed on the reflector 25 as described above reflects the infrared light emitted from the halogen heater 23, and the reflected light irradiates the nip formation pad 24. As a result, the halogen heater 23 directly irradiates the nip formation pad 24 with the infrared light, and, additionally, the nip formation pad 24 is also irradiated with the infrared light reflected by the reflection face 40. Therefore, the nip formation pad 24 is effectively heated. In addition, reflection of the infrared light by the reflection face 40 can prevent the reflector 25 from being heated and reduce waste of energy.

[0040] Additionally, in the present embodiment, since the reflector 25 functions as a support that supports the nip formation pad 24, a separate support is not needed. Setting the separate support needs forming the reflector thinly to dispose the reflector in a narrow space between the separate support and the halogen heater 23. Forming the reflector thinly results in a small thermal capacity of the reflector, and the temperature of the reflector is likely to increase. As a result, the temperature of the reflector becomes high in a short time, and the reflector may tarnish and reduce the reflectance. In contrast, the reflector 25 in the present embodiment having the function of the support enables making the thick reflector 25 having a large thermal capacity, which moderates temperature rise caused by the radiant heat from the halogen heater 23. Thereby, even if the halogen heater 23 is used continuously for a long time, the large thermal capacity can prevent the reflector 25 from becoming high temperature, tarnishing, and lowering the reflectance and maintain high heating efficiency.

[0041] Incidentally, some of the infrared light reflected by the reflector 25 irradiates the halogen heater 23. Therefore, the reflection face 40 formed over the entire inner surface of the reflector 25 increases the amount of infrared light reflected toward the halogen heater 23, and continuous use of the halogen heater 23 for a long time may cause the temperature rise of the heater 23 that exceeds the heat resistance temperature of the halogen heater 23.

[0042] Therefore, in the present embodiment, as illustrated in FIG. 7, the reflection face 40 is not formed in a part of the surface of the bottom wall portion 25b, that is, the central part D and the vicinity of the central part, in the inner surface of the reflector 25, and the surface that is not mirror-finished and has a reflectance of less than 70% is exposed. Removing the reflection face 40 from a part of the surface in the inner surface of the reflector 25 can reduce the amount of infrared light reflected toward the halogen heater 23 compared to the reflector 25 having the reflection face 40 formed over the entire inner surface.

[0043] In the present embodiment, the part of the surface in which the reflection face 40 is not formed is the central part D and the vicinity of the central part D in the bottom wall portion 25b. This part is on a plane orthogonal to imaginary lines extending radially from the center Q of the halogen heater 23 on a plane intersecting the width direction of the fixing belt 21 illustrated in FIG. 7. That is, this part is on the plane to which the infrared light from the halogen heater 23 is emitted perpendicular. The infrared light emitted perpendicular to the reflector and once reflected by the reflector reaches the halogen heater 23. Energy attenuation caused by the reflection is small. Therefore, the infrared light emitted perpendicular to the reflector greatly affects the temperature rise of the halogen heater 23. Removing the reflection face 40 from the above-described part of the surface of the reflector 25 to which the infrared light is emitted perpendicular can effectively reduce the temperature rise in the halogen heater 23 caused by the reflected infrared light.

[0044] Removing the reflection face 40 from the part of surface of the reflector 25, preferably, the part including the surface to which the infrared light is emitted perpendicular can reduce the amount of infrared light reflected toward the halogen heater 23. This can reduce temperature rise in the halogen heater 23 caused by the reflected infrared light, that is, prevent the temperature in the halogen heater 23 from rising excessively.

[0045] Other embodiments of the present disclosure are described below. The differences from the first embodiment are described below, in which only the differences with the first embodiment are described.

[0046] FIG. 8 is a vertical sectional view of the fixing device according to a second embodiment of the present disclosure viewed from the lateral side of the fixing device.

[0047] In the second embodiment illustrated in FIG. 8, the reflection face 40A is also formed by applying reflective material on the central part D and its vicinity in the bottom wall portion 25b of the reflector 25. However, the reflectance of the reflection face 40A formed on this part of the surface is set lower than the reflectance of the reflection face 40B formed on the part other than the central region D and its vicinity.

[0048] Forming the reflection face 40A on the part of surface having lower reflectance than the other part of surface as described above can reduce the reflected light toward the halogen heater 23. Therefore, this case can also reduce temperature rise caused by the reflected infrared light in the halogen heater 23, that is, prevent the temperature in the halogen heater 23 from rising excessively. That is, forming the reflection face 40A having lower reflectance on the part of the surface, that is, on

the central part D and its vicinity in the bottom wall portion 25b, to which the infrared light from the halogen heater 23 is emitted perpendicular, can effectively reduce the temperature rise in the halogen heater 23 caused by the reflected infrared light.

[0049] FIG. 9 is a vertical sectional view of the fixing device according to a third embodiment of the present disclosure viewed from the lateral side of the fixing device.

[0050] The fixing device according to the third embodiment illustrated in FIG. 9 is different from those according to the above-described embodiments in the arrangement of the halogen heater 23. In the embodiments illustrated in FIGS. 7 and 8 as described above, the halogen heater 23 is disposed at the center C of an inner space of the reflector surrounded by the nip formation pad 24 and the reflector 25 on the plane intersecting the width direction of the fixing belt 21. In contrast, in the third embodiment illustrated in FIG. 9, the halogen heater 23 is disposed closer to the nip formation pad 24 than the center C of the inner space of the reflector and upstream from the center C in a direction E of conveyance of the recording medium in the nip N. Since the arrangement of the halogen heater 23 closer to the nip formation pad 24 described above in the third embodiment shortens the distance between the halogen heater 23 and the nip formation pad 24, the halogen heater 23 effectively heats the nip formation pad 24.

[0051] Additionally, as illustrated in FIG. 9, in the third embodiment, the reflection face 40 is not formed on a part of the inner surface of the reflector 25 including a part F that is closest to a center Q of the halogen heater 23. The reflection face 40 is formed on the inner surface of the reflector 25 other than the part described above.

[0052] Removing the reflection face 40 from the part of surface of the reflector 25 including the part F that is closest to the center Q of the halogen heater 23 as described above can reduce the amount of infrared light reflected toward the halogen heater 23 and the temperature rise in the halogen heater 23 caused by the reflected infrared light. That is, removing the reflection face 40 from the part on the plane to which the infrared light from the halogen heater 23 is emitted perpendicular, that is, the plane intersecting orthogonal to imaginary lines extending radially from the center Q of the halogen heater 23 can effectively reduce the temperature rise in the halogen heater 23 caused by the reflected infrared light.

[0053] FIG. 10 is a vertical sectional view of the fixing device according to a fourth embodiment of the present disclosure viewed from the lateral side of the fixing device.

[0054] Contrary to the third embodiment illustrated in FIG. 9, in the fourth embodiment illustrated in FIG. 10, the halogen heater 23 is arranged downstream from the center C of the inner space of the reflector in the direction E of the conveyance of the recording medium in the nip N. Forming the reflection face 40 on the surface of the reflector 25 other than the part of surface of the reflector 25 including a part G that is closest to the center Q of the halogen heater 23 can also reduce the infrared light reflected toward the halogen heater 23 and the temperature rise in the halogen heater 23 caused by the reflected infrared light. That is, removing the reflection face 40 from the part on the plane to which the infrared light from the halogen heater 23 is emitted perpendicular, that is, the plane intersecting orthogonal to imaginary lines extending radially from the center Q of the halogen heater 23 can effectively reduce the temperature rise in the halogen heater 23 caused by the reflected infrared light.

[0055] Alternatively, the reflection face may be formed on the part of the inner surface of the reflector 25 and set the reflectance lower than the reflection face formed on the other part of the inner surface of the reflector 25 in the configurations illustrated in FIGS. 9 and 10 in which the halogen heater 23 is located at a position shifted from the center C of the inner space of the reflector 25. This can also reduce the infrared light reflected toward the halogen heater 23 and the temperature rise in the halogen heater 23 caused by the reflected infrared light.

[0056] FIG. 11 is a vertical sectional view of the fixing device according to a fifth embodiment of the present disclosure viewed from the lateral side of the fixing device.

[0057] The fixing device according to the fifth embodiment illustrated in FIG. 11 has the same arrangement of the halogen heater 23 in the fixing device according to the first embodiment illustrated in FIG. 7 but is different in the part in which the reflection face 40 is not formed. In the first embodiment illustrated in FIG. 7, the reflection face 40 is not formed at the part of the surface on the bottom wall portion 25b of the reflector 25. In contrast, in the fifth embodiment illustrated in FIG. 11, the reflection face 40 is not formed at a part of the surface on each of side wall portions 25a of the reflector 25. As described above, the reflection face 40 may be removed from the part of surface on each of the side wall portions 25a in the configuration in which the halogen heater 23 is disposed in the center C of the inner space of the reflector.

[0058] In the fifth embodiment illustrated in FIG. 11, the part in which the reflection face 40 is not formed is on the plane to which the infrared light from the halogen heater 23 is emitted perpendicular and includes a part K that is closest to a center Q of the halogen heater 23. Removing the reflection face 40 from the part described above can effectively reduce the infrared light reflected toward the halogen heater 23.

[0059] FIG. 12 is a vertical sectional view of the fixing device according to a sixth embodiment of the present disclosure viewed from the lateral side of the fixing device.

[0060] In the sixth embodiment illustrated in FIG. 12, the reflector 25 is configured by a pair of L-shaped divided reflectors 50 having the shape of the reflector 25 illustrated in FIG. 7 but divided into two. Other than that, the configuration illustrated in FIG. 12 is similar to that in the first embodiment illustrated in FIG. 7. Each divided re-

flector 50 includes a side wall portion 25a and a bottom wall portion 25b orthogonal to or intersecting with the side wall portion 25a. As illustrated in FIG. 12, the divided reflectors 50 are arranged to face each other, and as a whole, the reflector 25 has a U-shaped cross-section.

[0061] As illustrated in FIG. 12, in the sixth embodiment, not forming the reflection face 40 at the part of the surface of the each bottom wall portion 25b in the inner surface of the reflector 25, that is, end portions of the bottom wall portions 25b facing each other and their vicinities, can reduce the amount of infrared light reflected toward the halogen heater 23 and the temperature rise in the halogen heater 23 caused by the reflected infrared light.

[0062] FIG. 13 is a vertical sectional view of the fixing device according to a seventh embodiment of the present disclosure viewed from the lateral side of the fixing device.

[0063] In the seventh embodiment illustrated in FIG. 13, the reflector 25 is formed in a curved shape as a whole in the cross-section intersecting the width direction of the fixing belt 21, which is different from the above-described embodiments including straight side wall portions 25a and a straight bottom wall portion 25b. In the seventh embodiment, removing the reflection face 40 from the part of surface on the reflector 25 including the part L that is closest to the center Q of the halogen heater 23 can effectively reduce the temperature rise in the halogen heater 23 caused by the reflected infrared light. The shape of the reflector 25 may be an arc shape that is a part of a perfect circle, an elliptical shape, a combination thereof, or other curves. Preferably, the halogen heater 23 is arranged to avoid the focal point at which the reflected light from the reflection face 40 is collected. For example, since the focal point of the reflected light by the arc shaped reflection face 40 is closer to the reflection face 40 than the center of the arc of the reflection face 40, the halogen heater 23 is preferably arranged to be closer to the center of the arc of the reflection face 40 than the focal point of the reflected light, that is, farther away from the reflection face 40 with respect to the focal point of the reflected light.

[0064] Although removing the reflection face 40 from a part of the surface on the reflector 25 reduces the infrared light reflected toward the halogen heater 23 in each of the above-described embodiments illustrated in FIGS. 11 to 13, forming the reflection face on the part of the surface on the reflector 25 to have the lower reflectance than the other part of the surface on the reflector 25 may also reduce the infrared light reflected toward the halogen heater 23 in these embodiments.

[0065] Additionally, in each of the embodiments illustrated in FIGS. 1 to 13, the reflectance of the reflection face 40 (40A, 40B) may be differently changed in the width direction of the fixing belt 21. Since the heat given from the halogen heater 23 to the fixing belt 21 and the nip formation pad 24 is radiated through the side plate, the temperature at the end portions of the fixing belt 21 in the width direction is less likely to rise than the one at the center portion of the fixing belt 21.

[0066] Therefore, in order to shorten a waiting time until the temperature at the end portion reaches a predetermined temperature, the reflectance at end ranges H2, which is outside a recording medium conveyance area W, of the reflection face 40 formed on the reflector 25 illustrated in FIG. 3 in the width direction of the fixing belt 21 may be set larger than the reflectance at center range HI, which is inside the recording medium conveyance area W.

[0067] Setting the reflectance of the reflection face 40 at the end ranges H2 higher than the one at the center range H1 increases an amount of the reflected light at the end ranges H2 and, therefore, can achieve effective heating of the end portions of the fixing belt 21 via the nip formation pad 24. This accelerates heating of the end portions of the fixing belt 21 and can shorten the waiting time required for the temperature rise.

[0068] In addition to the reflectance, a shape of the reflector 25 may be changed between the center range H1 and the end ranges H2 to accelerate the temperature rise in the end portion of the fixing belt 21. For example, a sectional shape of the reflector 25 in the center range H1 may be made the sectional shape as illustrated in FIG. 7, and a sectional shape of the reflector 25 in the end ranges H2 may be made the sectional shape as illustrated in FIG. 14 in which more light is reflected onto the nip formation pad 24. In the example illustrated in FIG. 14, the reflector 25 includes inclined wall portions 25c that each are disposed between each of the side wall portions 25a and the bottom wall portion 25b and incline toward each of the side wall portions 25a and the bottom wall portion 25b. Since the reflection face 40 is formed on the side wall portions 25a and the inclined wall portions 25c in the end ranges H2 of the reflector 25, the shape of the reflection face 40 in the center range H1 is different from the shape of the reflection face 40 in the end range H2.

[0069] Forming the shape of the reflector 25 and the shape of the reflection face 40 at the end ranges H2 so that more light is reflected onto the nip formation pad 24 than is reflected with the shape of the reflector 25 and the shape of the reflection face 40 at the center range H1 can achieve effective heating of the end portions of the fixing belt 21. The above-described configuration accelerates heating of the end portions of the fixing belt 21 and can shorten the waiting time required for the temperature rise.

[0070] As illustrated in FIG. 14, not forming the reflection face 40 at the part of the inner surface of the reflector 25, that is, the center portion J of the bottom wall portion 25b and its vicinity, in the end ranges H2 can reduce the amount of infrared light reflected toward the halogen heater 23 and the temperature rise in the halogen heater 23 caused by the reflected infrared light. That is, similar to the above-described embodiments, in this embodiment, removing the reflection face 40 from the part on

the plane to which the infrared light from the halogen heater 23 is emitted perpendicular can effectively reduce the temperature rise in the halogen heater 23 caused by the reflected light.

[0071] As described above, according to the present disclosure, a part of the surface of the reflector on the heater side having the lower reflectance than the other part of the surface of the reflector can reduce the radiant heat reflected to the heater. Such a configuration can reduce temperature rise in the heater caused by the radiant heat reflected to the heater and prevent thermal degradation and damage of the heater. Note that "the part of the surface having the lower reflectance" in the present disclosure means the part of the surface in which the reflection face is not formed, such as the part of the surface in which the reflective material is not applied or the part of the surface that is nor mirror-finished, in addition to the part of the surface in which the reflection face having the lower reflectance than the reflection face in the other part of surface is formed.

[0072] The present disclosure is not limited to the above-described embodiments, and the configuration of the present embodiment can be appropriately modified other than suggested in each of the above embodiments within a scope of the technological concept of the present disclosure. Also, the positions, the shapes, and the number of components are not limited to the embodiments, and may be modified suitably in implementing the present disclosure.

[0073] In addition, the present disclosure may be applicable to the fixing device 5 as illustrated in FIG. 15 that conveys the sheet in the vertical direction in addition to the fixing device 5 as illustrated in FIG. 1 that conveys the sheet in the horizontal direction.

Claims

1. A fixing device (5) comprising:

a cylindrical fixing member (21);
an opposed member (22) disposed opposite an outer surface of the fixing member (21);
a nip formation pad (24) disposed inside a loop of the fixing member (21) to sandwich the fixing member (21) with the opposed member (22) to form a nip between the fixing member (21) with the opposed member (22);
a heater (23) disposed inside the loop of the fixing member (21) to heat the nip formation pad (24); and
a reflector (25) that includes a part of a surface facing the heater (23) and having a lower reflectance than another part of the surface of the reflector (25), at least a part of the reflector (25) disposed between the fixing member (21) and the heater (23) in a cross-section that intersects a width direction of the fixing member (21).

2. The fixing device (5) according to claim 1,
wherein the part of the surface of the reflector (25) facing the heater (23) and having the lower reflectance than said another part of the surface of the reflector (25) includes a plane orthogonal to an imaginary line extending radially from a center of the heater (23) on the cross-section intersecting the width direction of the fixing member (21).

3. The fixing device (5) according to claim 1,
wherein the part of the surface of the reflector (25) facing the heater (23) and having the lower reflectance than said another part of the surface of the reflector (25) includes a plane of the reflector (25) closest from a center of the heater (23).

4. The fixing device (5) according to any one of claims 1 to 3,
wherein the heater (23) is disposed closer to the nip formation pad (24) than a center of an inner space surrounded by the reflector (25) and the nip formation pad (24) and upstream or downstream from the center in a direction of conveyance of a recording medium in the nip.

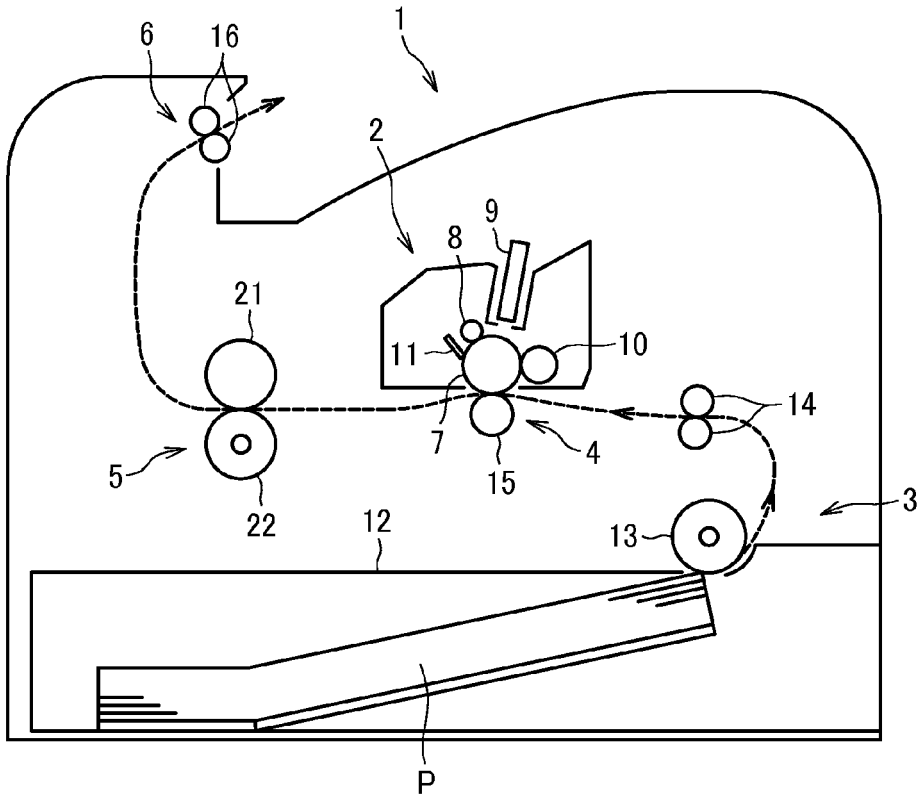
5. The fixing device (5) according to any one of claims 1 to 4,
wherein the reflector (25) has a higher reflectance in an end range than in a center range in the width direction of the fixing member (21).

6. The fixing device (5) according to any one of claims 1 to 5,
wherein a shape of an end range of the reflector (25) is different from a shape of a center range of the reflector (25) in the width direction of the fixing member (21).

7. An image forming apparatus comprising:

an image forming device (2) to form an image on a recording medium; and
the fixing device (5) according to any one of claims 1 to 6 to fix the image formed by the image forming device (2) onto the recording medium.

FIG. 1


1
6
16
2
9
8
21
11
10
14
7
4
15
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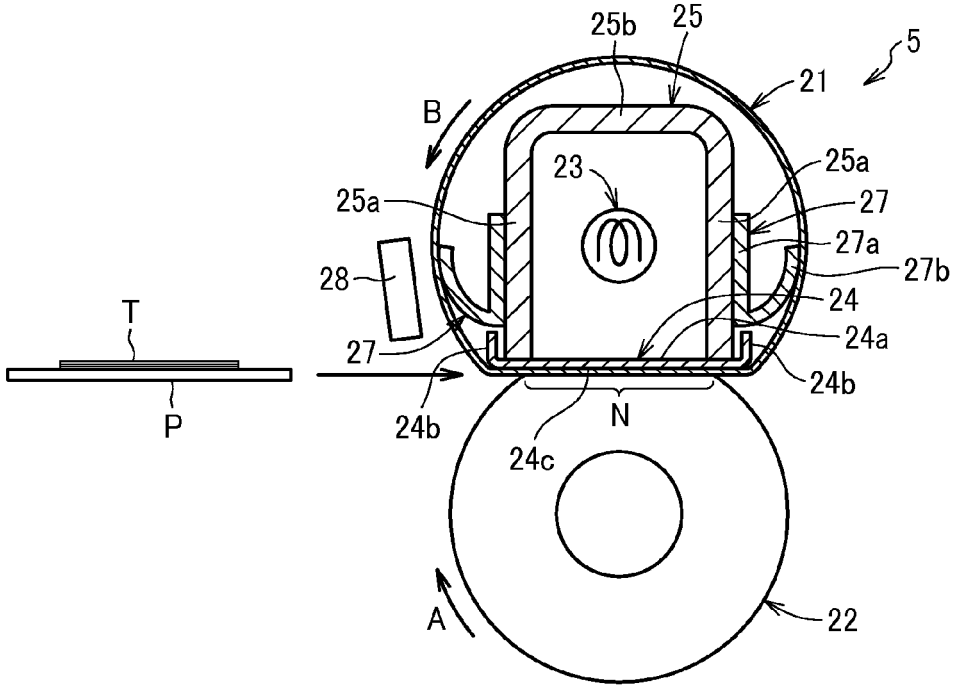
22
12
13
3
P

FIG. 2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21
B
25a
23
25a
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27a
27b
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24
T
27
24a
24b
24b
N
24c
P
A
22

FIG. 3

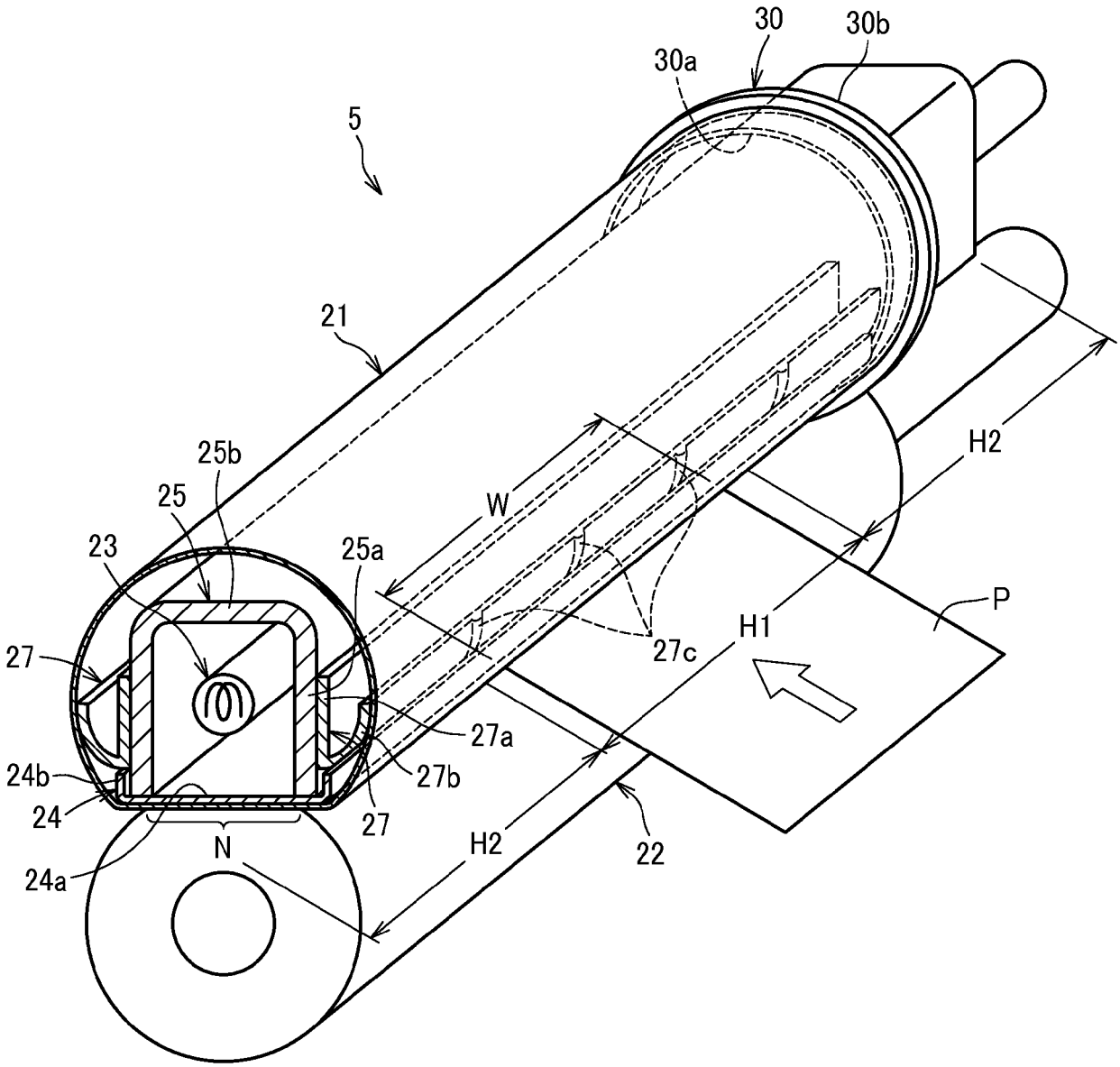

30
30b
30a
5
21
25b
25
23
25a
W
H2
H1
P
27c
27
27a
27b
24b
24
24a
N
H2
22

FIG. 4

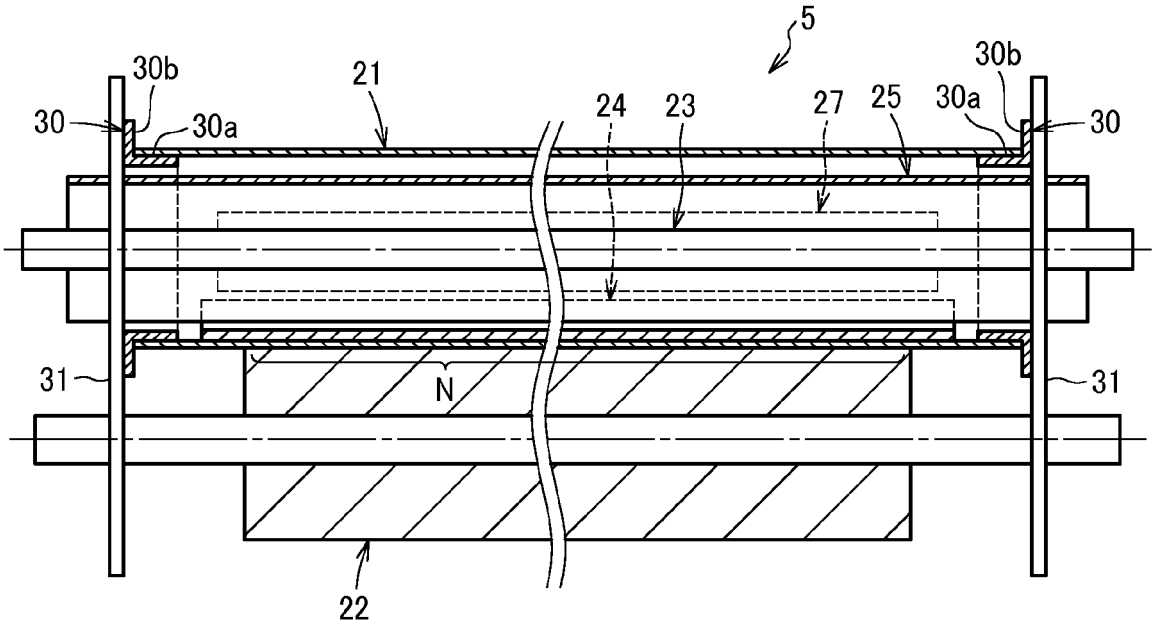


FIG. 5

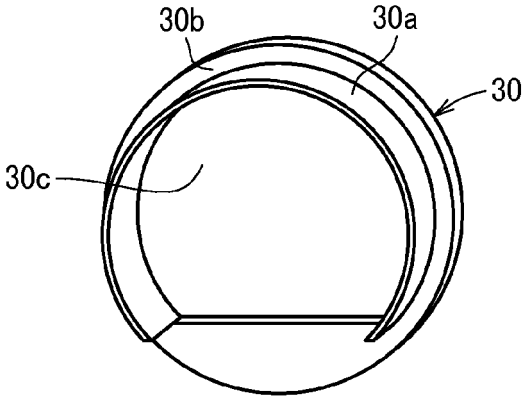


FIG. 6

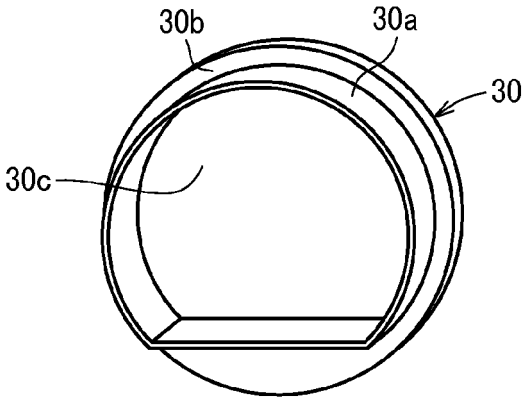
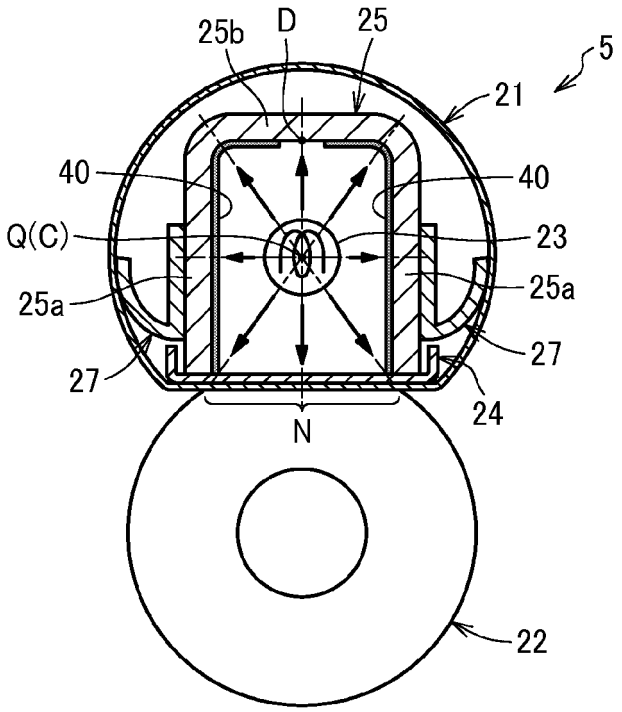


FIG. 7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D
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5
21
40
40
Q(C)
23
25a
25a
27
27
24
N
22

FIG. 8

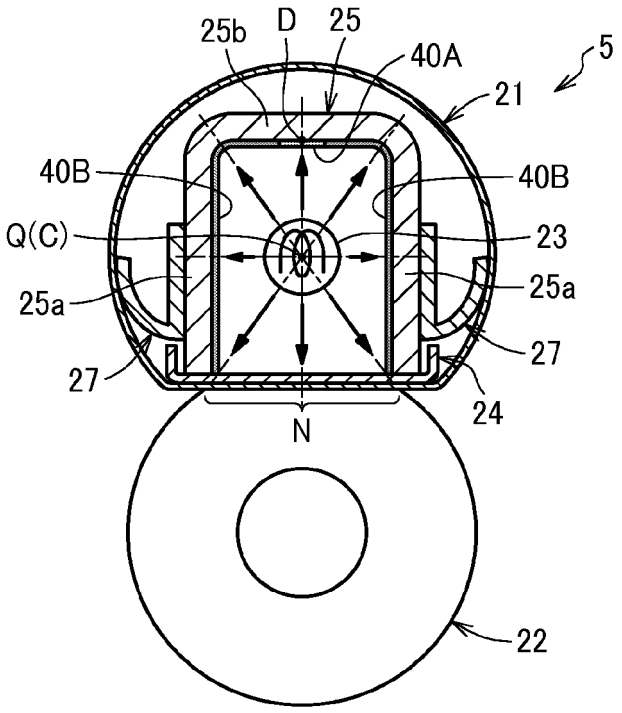
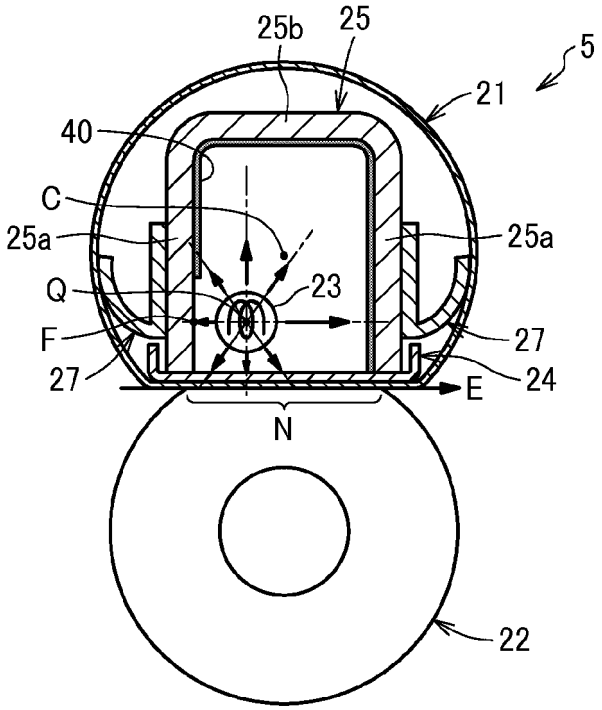

25b
D
25
40A
5
21
40B
40B
Q(C)
23
25a
25a
27
27
24
N
22

FIG. 9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25
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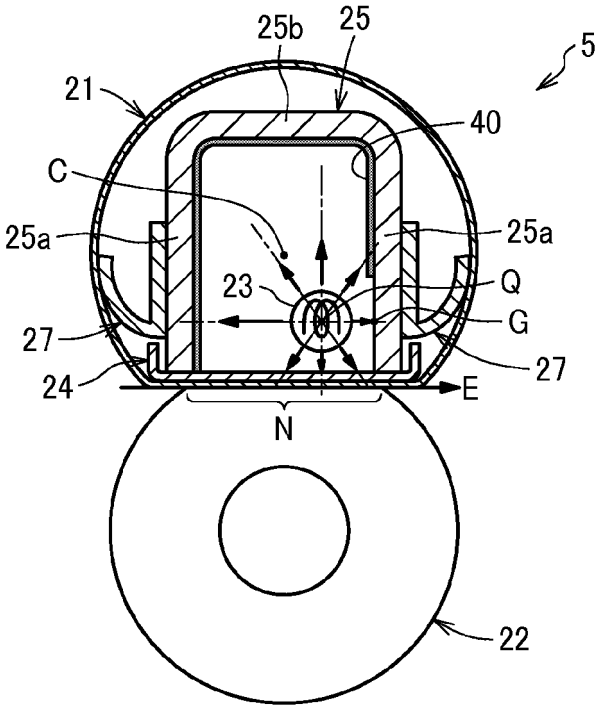
21
40
C
25a
25a
Q
23
F
27
27
24
E
N
22

FIG. 10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25
5
21
40
C
25a
25a
23
Q
G
27
27
24
E
N
22

FIG. 11

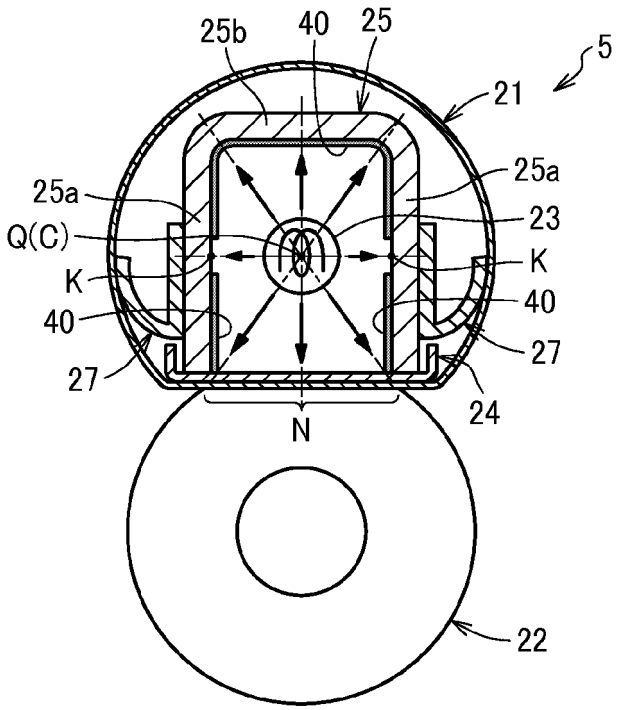

25b
40
25
5
21
25a
25a
23
Q(C)
K
K
40
40
27
27
24
N
22

FIG. 12

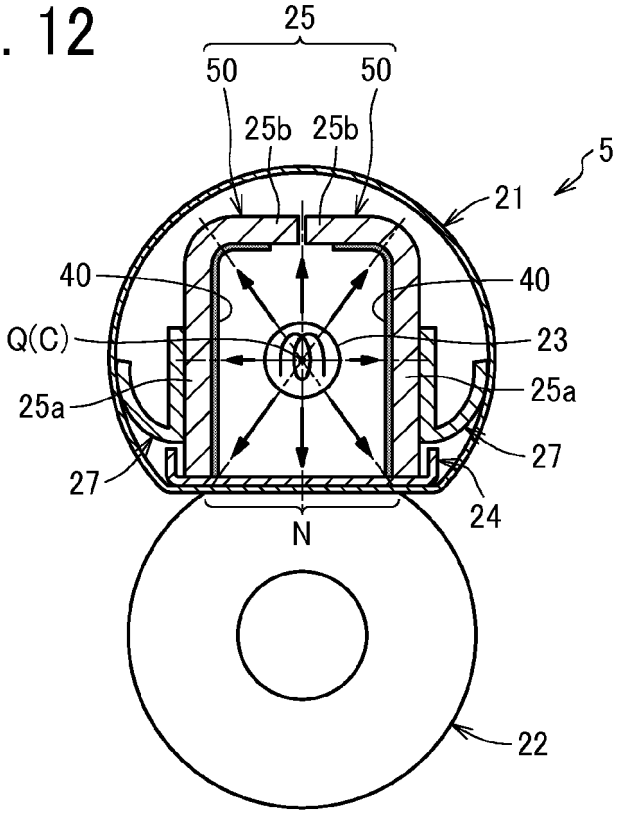
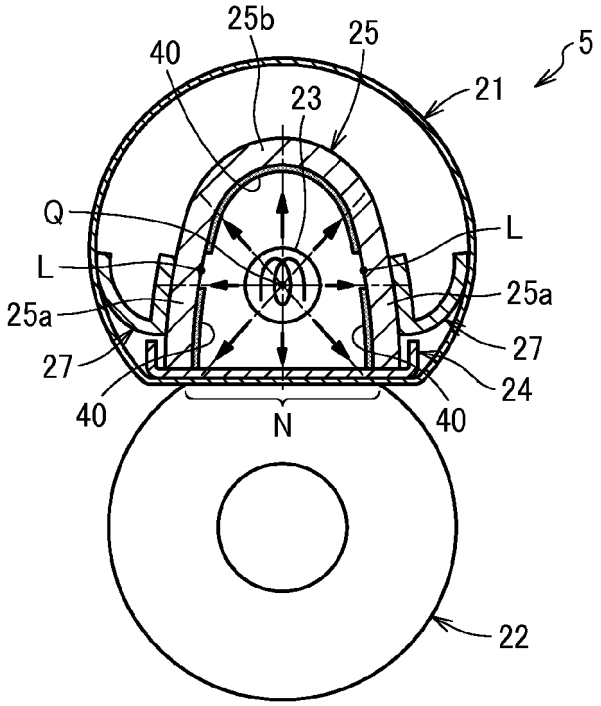

25
50
50
25b
25b
5
21
40
40
Q(C)
23
25a
25a
27
27
24
N
22

FIG. 13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23
Q
L
L
25a
25a
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27
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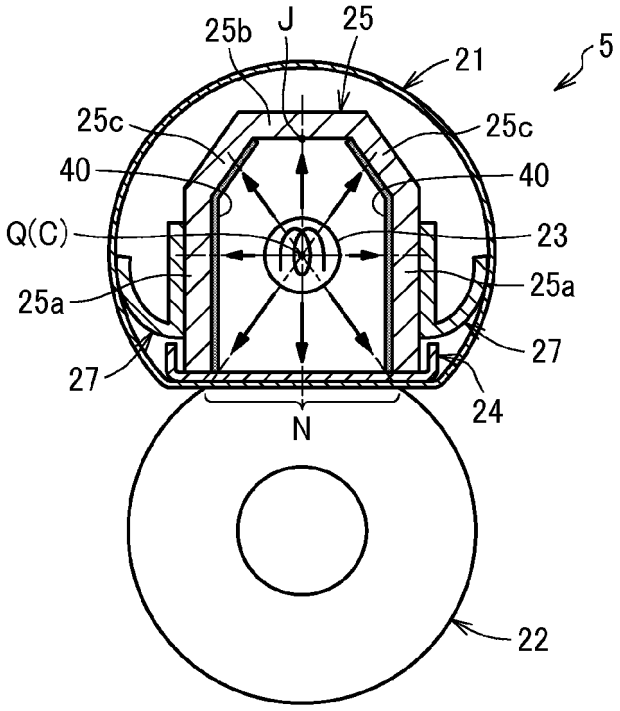
N
40
22

FIG. 14


25b
J
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5
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25c
25c
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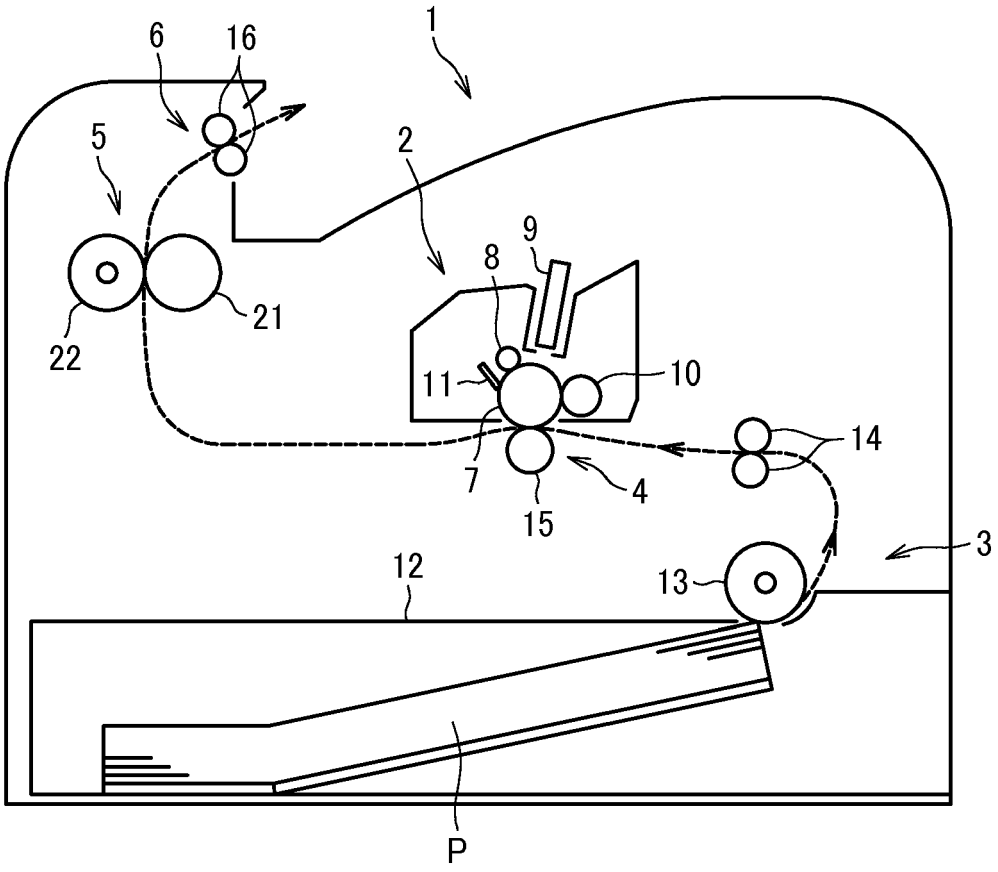
40
Q(C)
23
25a
25a
27
27
24
N
22

FIG. 15



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EUROPEAN SEARCH REPORT

Application Number
EP 19 21 0703

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2014/079455 A1 (SEKI TAKAYUKI [JP] ET AL) 20 March 2014 (2014-03-20) * paragraph [0036] - paragraph [0173]; figures 1-22B *	1-7	INV. G03G15/20
A	US 2016/231673 A1 (ISHIDA KEI [JP]) 11 August 2016 (2016-08-11) * paragraph [0015] - paragraph [0061]; figures 1-5 *	1-7	
A	US 2011/188908 A1 (ISHIDA KEI [JP] ET AL) 4 August 2011 (2011-08-04) * paragraph [0023] - paragraph [0102]; figures 1-14 *	1-7	
A	US 2014/016971 A1 (ARAI YUJI [JP] ET AL) 16 January 2014 (2014-01-16) * paragraph [0045] - paragraph [0143]; figures 2-16B *	1-7	
A	US 2013/209147 A1 (OGAWA TADASHI [JP] ET AL) 15 August 2013 (2013-08-15) * paragraph [0037] - paragraph [0228]; figures 1-15 *	1-7	TECHNICAL FIELDS SEARCHED (IPC) G03G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 April 2020	Tomezzoli, Giancarlo

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28-04-2020

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